

INVITED ABSTRACT FOR SPRING 1995 MRS MEETING

Submitted to Symposium G

Symposium Title: Structure and Properties of Multilayered Thin Films



MULTILAYER OPTICS FOR THE X-RAY, SOFT X-RAY AND EXTREME ULTRA-VIOLET SPECTRAL RANGES, T. W. Barbee, Jr., Chemistry and Materials Science Department, Lawrence Livermore National Laboratory, Livermore, CA, 94551.

The optical constants of the elements precludes their application as single layer reflecting or transmission optic structures in the x-ray (XR, $E > 3000$ eV), soft x-ray (SXR, $3000 \text{ eV} \geq E \geq 100 \text{ eV}$) and the extreme ultra violet (EUV, $100 \text{ eV} \geq E \geq 15 \text{ eV}$) except in reflection at grazing angles of incidence. This characteristic has limited XR, SXR and EUV optic systems to such grazing incidence structures which are complex, technologically taxing, difficult to align and aberration sensitive. This limitation has been removed by the development of man-made depth periodic multilayer structures of sufficient perfection to be applied as Bragg reflecting optics at angles approaching normal incidence for energies $E \leq 300 \text{ eV}$. This advance was enabled by the development of materials synthesis techniques which may be applied to the fabrication of these multilayer structures with control of the multilayer period at the 0.01 nm level. Note, 0.01 nm is approximately 4% of the typical interplanar spacing or atomic diameter in solids. Thus, multilayer optic structures represent materials engineering at the atomic level. In this paper material selection, multilayer deposition and optic performance will be reviewed. The effects of interfacial structure and chemical reactions between component layers will be emphasized. Examples of new science and technology enabled by these multilayer XR, SXR and EUV optics will be presented.

This work was performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48.

Contact Author:

T. W. Barbee, Jr.
Chemistry and Materials Science Department
P.O. Box 808, L-350
Lawrence Livermore National Laboratory
Livermore, CA 94551
(510) 423-7796
(510) 422-6892 FAX

Presenting Author:

Troy W. Barbee, Jr.